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OCCURRENCE OF ADULT AMERICAN DOG TICK, *DERMACENTOR VARIABILIS* (SAY), AROUND SMALL MAMMAL TRAPS AND VERTEBRATE CARCASSES[1]

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Abstract.—We report on the distribution of unfed adult American dog ticks, *D. variabilis,* in a wet meadow in which meadow voles, *Microtus pennsylvanicus,* were being live-trapped. Areas of 0.3 m radius around Fitch and Sherman® small mammal live traps were each visually searched for ticks for 30 s, as were an equal number of similar circles halfway between traps. In 1981 and 1982, 482 ticks were found around traps and 3 in intertrap circles. In 1983, 20 ticks were around traps and 1 between traps. During July, 1981, 48 of 50 traps had ticks around them, while no ticks were found in the intertrap circles. Unfed *D. variabilis* adults were also observed around vertebrate carcasses, including those of various fish and a black rat snake, *Elaphe obsoleta obsoleta. D. variabilis* adults moved into cages baited with dead fish and assumed questing attitudes; no ticks were found in the unbaited cages. In mid-May 194 unfed *D. variabilis* adults were found within 1 m of the carcass of a white-tailed deer, *Odocoileus virginianus borealis,* which had died during the winter when *D. variabilis* adults are not on hosts.

Smith et al. (1946) reported that American dog tick, *Dermacentor variabilis* (Say), adults were apparently attracted to animal odors, such as urine. Although Sonenshine et al. (1966) in Virginia found *D. variabilis* adults to be relatively sedentary, they suggested that these ticks might traverse short distances to sources of attraction. Our observations of numbers of *D. variabilis* adults around small mammal live traps and vertebrate carcasses prompted us to investigate the distribution of *D. variabilis* adults around live traps in a meadow and their possible attraction to vertebrate carcasses. The ability to influence tick distribution under field conditions might have applications in managing their populations.

Materials and Methods

The study area.—The study site at the Patuxent Wildlife Research Center in Laurel, Maryland, fit Hotchkiss and Stewart's description (1979) of a sweetgum field, the successional stage between a wet meadow and an immature seepage

[1] This paper reflects the results of research only. Mention of a proprietary product or a pesticide does not constitute an endorsement or a recommendation of this product by the USDA.

swamp. The field contained a variety of wet meadow plants, including an abundance of grasses, and scattered sweetgum, *Liquidambar styraciflua* L., saplings and autumn olive, *Elaeagnus umbellata* Thunb., bushes. The field was bordered on two sides by a mature deciduous hedgerow. Most of the borders of the other two sides were two man-made ponds, one of which had a ca. 2 m high dike. Adjacent to the dike was a narrow (1.5–2 m) wetter strip of the meadow, where sedges and rushes grew. The surrounding woodlands were bottomland forest and beech-white oak forest.

Distribution of ticks around live animal traps.—A 0.8 hectare grid containing 100 Fitch traps was established in the meadow 1 year prior to the start of this tick study for a capture and release population study of meadow voles, *Microtus pennsylvanicus* (Ord) (Nichols et al., 1984). Voles were trapped and released in the grid for three or five consecutive days monthly through 1983. The traps were in 10 rows of 10 traps each, and each trap was 7.6 m from the adjacent traps in its row and column. Each trap contained a handful of hay and dried grass, and was left open between monthly trapping periods, thus allowing voles free access. During the second year of the study the Fitch traps, which were being tipped over by deer, were replaced with Sherman traps, and four raccoon traps were placed on the grid.

To assess the distribution of *D. variabilis* adults within the trapping grid, we visually searched for ticks within a 0.3 m radius from the approximate center of a trap. Nine to 50 trap areas were searched on any given day. Each area was searched for 30 s. If no ticks were detected after 25 s, the searcher lightly brushed his hand and arm through the vegetation in the search area to pick up unseen questing ticks which were immediately released in the circle. On the same day this search procedure was repeated for an equal number of circles of the same area halfway (3.8 m) between traps in the same rows or columns. A total of 12 counts were made June–August in 1981, June and July of 1982, and in July 1983.

Movement of ticks to animal traps.—*D. variabilis* adults were collected by flagging at the study site, and each marked with an enamel dot of any of three colors. At each of the cardinal directions a group of seven ticks was released 0.3, 0.6 and 1.2 m from the approximate center of a Fitch trap. The colors of the dots denoted the distance the ticks were released from the trap. A circular area with the trap as center was searched for marked ticks 1, 5 and 7 d after their release. The innermost area (<0.3 m from the trap) was searched for about 1 min, the middle area (a ring, 0.3–0.6 m from the trap) for 3 min, the outer area (a ring, 0.6–1.2 m from the trap) for 11 min and 5 min were spent searching beyond 1.3 m from the trap. This procedure was repeated at a second trap, except the recaptures were attempted only on the day following release.

Attraction to animal carcasses.—To determine if *D. variabilis* adults were attracted to non-mammalian vertebrate carcasses, two dead fish were placed inside a cage (25 cm long, 10 cm diam) of hardware cloth (0.64 cm mesh) in the meadow. A larger cage (1.3 m high, 1.1 m diam) of hardware cloth was centered over the smaller cage. The outer cage was open on the bottom and the inner and outer cages were held in place by wires pushed into the soil. An identical pair of unbaited cages was placed 1 m from the one described. We wore vinyl gloves and plastic wrist-to-elbow sleeves when constructing and setting out the cages in order to

Table 1. *D. variabilis* adults observed around (0.3 m radius) small mammal traps and within circles of the same radius between traps.[a]

Date	No. Traps and Intertrap Circles	No. Ticks[b] <0.3 m from Traps	Avg. No. Ticks/Trap	% Traps with Ticks	No. Ticks in Intertrap Circles	Avg. No. Ticks/Circle	% Circles with Ticks
(1981 and 1982)							
June 7	15	11	0.7	53.3	1	0.07	6.7
June 21	9	91	10.1	100	0	0	0
June 22	30	44	1.5	50	1	0.03	3.3
June 23	20	27	1.4	55	0	0	0
July 7	30	156	5.2	96.7	0	0	0
July 16	20	114	5.7	95	0	0	0
Aug. 13	50	17	0.3	28	1	0.02	2
Aug. 18	15	36	2.4	73.3	0	0	0
(1983)[c]							
July 5	20	8	0.4	20	0	0	0
July 11	30	8	0.3	20	0	0	0
July 12	20	3	0.2	15	1	0.05	5
July 13	14	1	0.1	7.1	0	0	0

[a] Traps were 7.6 m apart and circles were midway between traps.

[b] A total 230 ♂, 256 ♀ were found around traps and 2 ♂, 1 ♀ in intertrap circles in 1981 and 1982, and in 1983 10 ♂, 10 ♀ around traps and 1 ♂ in circles.

[c] Data from 1983 presented separately, because by that time vole and tick populations had declined dramatically (Nichols et al., 1984).

avoid contaminating the cages with our perspiration or skin oils. Two fish were added to the baited cage 6 and 12 d after the initial baiting. Black crappie, butterfish and ocean perch were used as bait. The cages and the vegetation within and 0.3 m outside the cages were searched for ticks before and periodically after the initial baiting. The *D. variabilis* population at the study site collapsed in 1983, so this procedure was not repeated until 1984.

A large concentration of ticks was found around the carcass of a white-tailed deer, *Odocoileus virginianus borealis* Miller, in mid-May. *D. variabilis* adults within 1 m of the carcass were counted periodically through August.

Results

Distribution of ticks around live animal traps.—*D. variabilis* adults were repeatedly present in considerable numbers around the small mammal traps, but found infrequently in the areas between traps (Table 1). The numbers of ticks around the traps changed seasonally, in accordance with reported cycles (Sonenshine et al., 1966), but few ticks were ever observed in the intertrap circles. In early and mid-July 1981, ticks were seen around 48 of 50 traps that were checked; averaging 5.4 ± 4.8 ticks per trap. During the same period no ticks were found in an equal number of stations between traps. As many as 34 ticks (16 ♂, 18 ♀) were seen within 0.3 m of a trap and as many as 11 ticks on a blade of grass. Most ticks seen around traps were 4–6 cm above the ground. They were rarely on the traps, but were frequently on vegetation hanging over the traps. It was not feasible to monitor the frequency and duration of visitations by voles to individual

traps. Voles were abundant in 1981 and 1982, and the population crashed by 1983 (Nichols et al., 1984). The raw data of Nichols et al. (1984) show trap catches of >70% on given dates during peak vole abundance.

Movement of ticks to animal traps.—Although some ticks moved more than 1 m in a day, there was no strong pattern of movement of marked *D. variabilis* adults toward the Fitch traps. One day after release less than half of the marked ticks were found within 1.2 m of traps (i.e. the furthest points of release). Only 11 and 13 marked ticks were found within 0.3 m of the Fitch traps. One trap was checked only the day after the ticks were released, but a week after release 13 of 15 marked ticks found less than 1.2 m from the second trap were within 0.3 m of it.

Attraction to animal carcasses.—Table 2 shows the attraction of *D. variabilis* adults to the fish carcasses in the hardware cloth cage in the meadow. In the first trial, 3 d after the fish were placed in the cages, just one tick was found on the outer cage of the baited set and none in either of them. No ticks were ever found in, on or within 0.3 m of the unbaited cage. Ten days after the initial baiting, six *D. variabilis* adults were observed inside the baited cage and clustered on vegetation above the fish. One week later eight ticks (5 ♂, 3 ♀) were in the cage with the fish. Except that on two occasions one tick was found within 0.3 m of the cage, similar results were obtained in the second trial.

D. variabilis adults were also found clustered around a dead black rat snake, *Elaphe obsoleta obsoleta* Say, and none 1–2 m away; further evidence of attraction to non-mammalian carcasses.

On May 19, 1981, 194 unfed *D. variabilis* adults were found within 1 m of the carcass of a white-tailed deer. The carcass was first noticed when fresh the previous January, a period when adult *D. variabilis* are not on hosts. The number of ticks around the carcass gradually decreased in ensuing weeks. On May 28 there were 155 ticks within 1 m of the carcass, while on June 21, 87 ticks, on June 30, 39 ticks and September 2, 20 ticks within 1 m of the carcass. The following spring there were still 10 ticks within 1 m of the carcass. Between May 19 and June 3 two ticks found, marked and released 6 m away from the carcass as part of another study moved to within 1 m of the carcass.

Discussion

A combination of factors may account for the clustering of ticks around the mammal traps: 1. Engorged nymphs drop off voles in and around traps, and remain under or near the traps until they molt into adults. We found engorged nymphs under traps on several occasions. 2. *D. variabilis* adults may be attracted, although based on our data not avidly, by odors associated with voles or by skin secretions from humans handling the traps, just as *D. variabilis* adults were attracted to stakes rubbed against dogs or soaked in their urine (Smith et al., 1946). 3. Aggregation pheromones may attract and retain ticks (Leahy et al., 1983). It is probably advantageous for adult *D. variabilis* to quest in areas of intense vole activity because of the opportunities of acquiring as hosts mammalian predators of voles.

The presence of ticks in the cages baited with fish seems to be due to attraction from outside or retention of transient ticks for five reasons: 1. We checked the vegetation under the traps for ticks when the cages were set up. 2. There was a

Table 2. Attraction of *D. variabilis* adults to fish carcasses in a 1.3 m diam cage of hardware cloth.[a]

Date	No. of Ticks					
	At Cage with Fish			At Empty Cage		
	<0.3 m Outside Cage	On Cage	In Cage[b]	<0.3 m Outside Cage	On Cage	In Cage
1982 Trial						
Aug. 13 (start)	0	0	0	0	0	0
16	0	1 ♂	0	0	0	0
23[c]	1 ♀	0	4 ♂, 2 ♀	0	0	0
30	0	0	5 ♂, 3 ♀	0	0	0
Sept. 2	1 ♀	0	2 ♂	0	0	0
14	0	1 ♀	1 ♂, 1 ♀	0	0	0
1984 Trial						
July 20 (start)	0	0	0	0	0	0
24	0	0	1 ♂	1 ♀	0	0
26	1 ♂	0	1 ♂, 4 ♀	1 ♀	0	0
Aug. 1	2 ♀	1 ♀	2 ♂, 1 ♀	0	0	0
7	1 ♂, 1 ♀	0	0	0	0	0

[a] Cages were 1 m apart in meadow. We wore disposable vinyl gloves and plastic sleeves when handling the cages to prevent contamination of them with perspiration and skin secretions.
[b] Ticks in the cage were concentrated within ca. 15 cm of the fish.
[c] Added two fish Aug. 19 and 25.

gradual increase in numbers of ticks in the baited cages. 3. The trials were at a time when it was unlikely that engorged nymphs, if any were hidden in litter below the traps, would molt to adults and start questing. 4. It is unlikely that unfed adult ticks of both sexes dropped from hosts attracted to dead fish. 5. Most of the ticks found were well inside the outer cage (only 2 on the outer cage and 2 < 0.3 m from it) which prevented mammalian scavengers close access to the fish. In New Jersey, P. P. Shubeck (pers. comm.) noticed ticks around carrion beetle (Coleoptera: Silphidae) traps (Shubeck, 1976) baited with chicken legs or fish. Although Semtner and Hair (1975) reported that *D. variabilis* adults are attracted to CO_2, the attractive factor in decomposing vertebrates needs to be identified.

The occurrence of the large numbers of adult *D. variabilis* around the deer carcass seems due to attraction. The deer died in the winter when *D. variabilis* are not on hosts. We found no partly fed female ticks. *D. variabilis* nymphs feed on small and medium-sized mammals. The ticks around the deer carcass, therefore, probably did not drop off the deer, but subsequently arrived at the carcass. If voles visited the carcass, fed nymphs might have dropped off near it and molted into adults, however, there is no evidence for this scenario. Since scavenging mammals visit carcasses, it would be of adaptive value to the ticks to quest around a vertebrate carcass mammalian.

These data indicate that the distribution of *D. variabilis* adults at the study site was influenced by the presence of mammalian and non-mammalian vertebrate carcasses, and by the vole trapping techniques. Also, *D. variabilis* adults were attracted into cages baited with fish or transient ticks remained in them. Waladde and Rice (1982) distinguished between ticks which actively hunt for hosts and

those which wait in ambush, but the case of *D. variabilis* is still not clearly defined. A person, by avoiding the live traps, was able to walk about the trapping grid, which at times harbored many ticks, and acquire few if any *D. variabilis* adults. Further study of factors which attract *D. variabilis* adults might lead to the development of methods of regulating the local distribution of questing ticks.

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